

CLAIMS:

1. A digital receiver, comprising:
 - a frequency converter arranged to convert a received signal into baseband signals;
 - delay units arranged to delay the baseband signals to provide delayed signals;
 - normalizing means arranged to truncate the baseband signals and the delayed signals to a predetermined length and provide normalized signals;
 - a demodulator arranged to demodulate the normalized signals and provide a demodulated signal; and
 - frequency offset sensing means arranged to sense an envelope of the demodulated signal to provide an offset signal indicative of a frequency offset of the received signal.
2. A digital receiver according to claim 1, wherein the normalizing means is arranged to truncate the baseband signals and the delayed signals by:
 - finding a signal with the largest absolute value among the baseband signals and the delayed signals;
 - determining a bit position of most significant bit of the signal; and
 - truncating each of the baseband signals and the delayed signals to the pre-determined length dependent upon the bit position.
3. A digital receiver according to claim 2, wherein the baseband signals and the delayed signals are signed signals.
4. A digital receiver according to claim 3, wherein each of the normalized signals include a sign bit of each of the baseband signals and the delayed signals.

5. A digital receiver according to claim 2, wherein the pre-determined length is so determined that the normalized signals do not degrade the performance of the receiver.

6. A digital receiver according to claim 1, wherein the frequency offset sensing means comprises:

means arranged to track the envelope of the demodulated signal to provide an envelope signal; and

filter arranged to low pass filter the envelope signal to provide the offset signal.

7. A digital receiver according to claim 6, wherein the filter is an adaptive IIR filter.

8. A digital receiver according to claim 6, wherein the sensing means further comprises a filter coefficient generator arranged to generate and adjust the coefficient of the filter.

9. A digital receiver according to claim 8, wherein the filter coefficient generator reduces the filter coefficient as a function of time.

10. A digital receiver according to claim 9, wherein the filter coefficient generator adjusts the filter coefficient according to the following:

$$\alpha_n = \frac{31}{32} \alpha_{n-1} + \frac{1}{32} * \frac{1}{256},$$

wherein α_n is the filter coefficient at time n, α_{n-1} is the filter coefficient at time n-1.

11. A digital receiver according to claim 1, wherein the demodulator further comprises a power normalizing means arranged to generate a power signal from

the normalized signals and provide a normalized demodulated signal to the sensing means.

12. A digital receiver according to claim 11, wherein the sensing means further comprises:

a reset signal generator for detecting the start of input data transmission and reset the sensing means.

13. A digital receiver according to claim 12, wherein the reset signal generator is arranged to detect the power signal to detect the start of transmission.

14. A digital receiver according to claim 12, wherein the reset signal generator further de-normalize the power signal dependent upon the bit position from the normalizing means.

15. A digital receiver according to claim 1, wherein the frequency converter comprises:

an analogue front-end arranged to convert a frequency of the received signal from a radio frequency into a low intermediate frequency to provide a low intermediate frequency signal.

16. A digital receiver according to claim 15, wherein the frequency converter further comprises:

an analogue-digital converter arranged to analogue-to-digital convert the low intermediate frequency signal to provide a digital signal;

mixers arranged to respectively mix the digital signal respectively with sine and cosine signals to obtain two orthogonal components; and

filters arranged to filter high frequency parts of the two orthogonal components to obtain the baseband signals.

17. A digital receiver according to claim 1, further comprising:
deciding means arranged to decide a tentative signal from the demodulated
signal and the offset signal.
18. A digital receiver according to claim 17, wherein the deciding means
comprises a comparator arranged to compare the demodulated signal with the
offset signal to provide the tentative signal.
19. A digital receiver according to claim 17, wherein the deciding means
comprises:
a subtractor arranged to subtract the offset signal from the demodulated
signal and provide a difference signal; and
a comparator arranged to compare the difference signal with zero to provide
the tentative signal.
20. A digital receiver according to claim 17, further comprising a symbol
timing recovery arranged to a symbol timing of the tentative signal.
21. A digital receiver according to claim 1, wherein the sensing means is
arranged to track the envelope of the demodulated signal by making the following
determinations:
if $x_n < x_{n-1} > x_{n-2}$ and $x_{n-1} > Min + threshold$ and $x_{n-1} < MAX$,
And if $x_{n-1} > Max$ or $x_{n-1} > dc_{n-1}$, then $Max = x_{n-1}$
if $x_n > x_{n-1} < x_{n-2}$ and $x_{n-1} < Max - threshold$ and $x_{n-1} > -MAX$,
And if $x_{n-1} < Min$ or $x_{n-1} < dc_{n-1}$, then $Min = x_{n-1}$
where, x_n, x_{n-1}, x_{n-2} are samples at time n, at time n-1 and at time n-2 of the
first input signal, respectively, dc_{n-1} is low frequency component of the envelope
of the demodulated signal at time n-1, Max and Min are the envelope signal

which represent negative and positive peaks of the envelope of the demodulated signal, and threshold and MAX are preset constants.

22. A digital receiver according to claim 12, wherein the threshold and MAX are proportional to a sampling duration, a modulation index or amplitude of the demodulated signal.

23. A digital receiver according to claim 12, wherein the filter is arranged to calculate the frequency component of the envelope signal of the form:

$$dc_n = (1 - \alpha_n)dc_{n-1} + \frac{\alpha_n}{2}(Max + Min)$$

where, dc_n is a frequency component of the envelope signal at time n, dc_{n-1} is the frequency component of the envelope signal at time n-1, α_n is the filter coefficient at time n.

24. A digital receiver, comprising:

a frequency converter arranged to convert a received signal into baseband signals;

delay units arranged to delay the baseband signals to provide delayed signals;

normalizing means arranged to truncate the baseband signals and the delayed signals to a predetermined length and provide normalized signals;

a demodulator arranged to demodulate the normalized signals and provide a demodulated signal; and

a filter arranged to filter the demodulated signal to provide a filtered signal and wherein the filter is arranged to have a bandwidth which decreases as a function of time.